



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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4037/24

May/June 2021

2 hours

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages.

Mathematical Formulae**1. ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series $u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY*Identities*

$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

Formulae for $\triangle ABC$

$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

1 Find the exact solution of the equation $\frac{p^{\frac{3}{2}} + p^{\frac{1}{2}}}{p^{-\frac{1}{2}}} = 4$. [3]

2 Find $\int \left(\frac{1}{2x-3} + \sqrt{x} \right) dx$. [3]

- 3 Variables x and y are such that when $\lg y$ is plotted against $\lg x$ a straight line passing through the points $(-1, -4)$ and $(2, 11)$ is obtained. Show that $y = ax^n$, where a and n are integers. [6]

- 4 The normal to the curve $y = x^5 - 2x^3 + x^2 + 3$ at the point on the curve where $x = -1$, cuts the x -axis at the point P . Find the equation of the normal and the coordinates of P . [7]

- 5 Solve the simultaneous equations $3y = x - 20$ and $x^2 + y^2 - 2x + 6y = 0$. [4]

6 The variables x and y are such that $y = \sqrt[3]{x^3 - 91}$.

(a) Find an expression for $\frac{dy}{dx}$. [2]

(b) Hence, find the approximate change in y as x increases from 6 to $6 + h$, where h is small. [2]

7 (a) Write the expression $4x^2 - 4x + 7$ in the form $p(x + q)^2 + r$, where p , q and r are constants. [3]

(b) Hence find the greatest value of $\frac{1}{4x^2 - 4x + 7}$ and state the value of x at which this occurs. [2]

8 (a) (i) Show that $\frac{\cos^2 2x}{1 + \sin 2x} = 1 - \sin 2x$. [2]

(ii) Hence solve $\frac{3 \cos^2 2x}{1 + \sin 2x} = 1$ for $0^\circ \leq x \leq 90^\circ$. [4]

(b) Solve $\cot\left(y - \frac{\pi}{2}\right) = \sqrt{3}$ for $0 \leq y \leq \pi$ radians. [3]

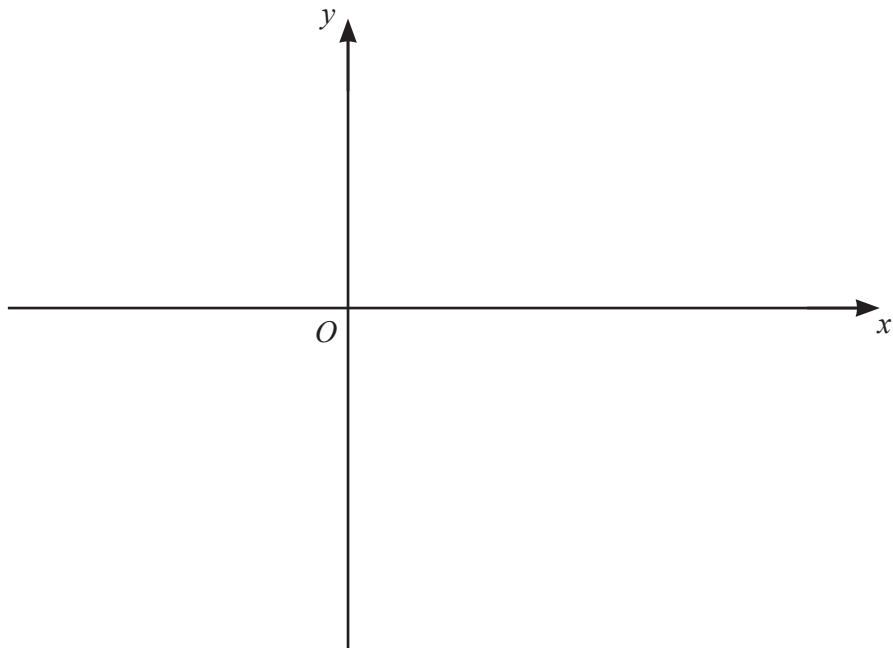
9 A function f is defined, for all real values of x , by $f(x) = 3 + e^{5x}$.

(a) Find the range of f . [1]

(b) Find an expression for $f^{-1}(x)$ and state its domain. [3]

(c) Solve $f^{-1}(x) = 0$. [2]

- (d) Sketch the graph of $y = f(x)$. Hence, on the same axes, sketch the graph of $y = f^{-1}(x)$. Give the coordinates of any points where the graphs cross the axes. [4]



- 10 (a)** A particle P travels in a straight line so that, t seconds after passing through a fixed point O , its displacement, s metres from O , is given by

$$s = \frac{31}{3} - \frac{e^t}{3} - 10e^{-t}.$$

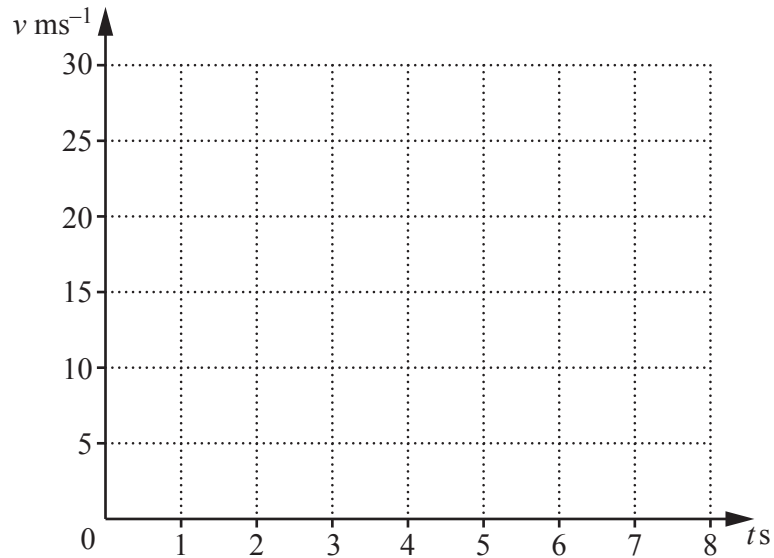
- (i)** Find the value of t when P is at instantaneous rest, giving your answer correct to 2 significant figures. [4]

- (ii)** Find the distance travelled in the first two seconds. [3]

- (b) A particle Q travels in a straight line so that t seconds after leaving a fixed point O , its velocity, $v \text{ ms}^{-1}$, is given by

$$\begin{aligned} v &= 2t && \text{for } 0 \leq t \leq 5, \\ v &= t^2 - 8t + 25 && \text{for } t > 5. \end{aligned}$$

- (i) On the axes below, sketch the velocity-time graph for the first 8 seconds of the motion of particle Q . [2]



- (ii) Showing all your working, find the distance travelled by Q in the first 8 seconds of its motion. [5]

- 11** OAB is a triangle. The position vectors of points A and B relative to the origin O are $\mathbf{a}$ and $\mathbf{b}$ respectively.

The side AB is extended to point C such that $AB = \frac{1}{4}AC$.

- (a)** Show that $\overrightarrow{OC} = 4\mathbf{b} - 3\mathbf{a}$. [2]

- (b) The point D lies on OA such that $OD : DA$ is $3 : 2$. The line CD meets OB at the point E . Find the position vector of the point E . [5]

- 12 (a) The first term of an arithmetic progression is -5 and the fifth term is 7 . Find the sum of the first 40 terms of this progression. [4]

- (b) A geometric progression has third term of 8 and sixth term of 0.064 . Find the sum to infinity of this progression. [4]

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